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SURVEY & CONTROL
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SOME ADDITIONAL TESTS OF CARPENTER ANT CONTROL MEASURES

By

R. L. Furniss
Associate Entomologist

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Rust
Ferrell
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Forest Insect Laboratory
445 U. S. Court House
Portland, Oregon
April 28, 1942

INDEX NO.—

U.S. GOVERNMENT PRINTING OFFICE 8—0742

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SOME ADDITIONAL TESTS OF CARPENTER ANT CONTROL MEASURES

By

R. L. Furniss

Associate Entomologist

445 U. S. Court House
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INTRODUCTION

The nature of the carpenter ant problem in the Pacific Northwest has been described in an earlier office report (3) covering investigations made in 1937. In that report, tests of 23 measures for controlling carpenter ants were summarized. Although most of these materials had at one time or another been recorded in the literature as being effective, none in the tests was found to be entirely satisfactory. A few were sufficiently promising to warrant further investigation. During 1938 and 1939 the more promising of these materials, together with a few previously untested materials, were subjected to additional tests. The results of this work are herein summarized. Information that has been gained from 201 cases of carpenter ant infestation, reported to the Portland Forest Insect Laboratory during the past several years, is also given.

As was the case in 1937, the materials were tested by treating carpenter ant colonies in stumps and down logs in the woods at Pack Forest, La Grande, Washington. Although the experimental conditions differed somewhat from those that would have been encountered in infested houses, it was considered likely that these differences would not seriously affect the results. Advantages in favor of the field tests were the numerous available colonies, and the fact that such colonies could be treated without accounting to home owners. A limited number of observations made in treated houses supplemented the field tests.

SECTION 1 - CONTROL TESTS

An effort was made to include five colonies in each of the tests, but when the treated logs and stumps were opened during the final examination, six colonies were found in four cases. In four tests one or more colonies were abandoned when the galleries were exposed. The indications were that the ants were present in these colonies at the time of treatment and that they subsequently moved, but this point could not be established with certainty. In the following discussion, the methods of treatment and the results of each test are given.

Baits

Baiting is one of the most commonly used methods for control of ants and has been widely advocated for controlling carpenter ants. In 1937 limited tests with baits containing paris green and thallium sulphate as the active ingredients showed no positive results. Since these tests were not deemed adequate to credit or discredit the method, additional baiting with tartar emetic and paris green was tried in 1938.

The bait was applied in wooden containers, 1¼" deep by 2½" by 4½" inside measurements. The bottom of each container was lined with roofing paper and the top covered with wire screen of either ¼-inch or ½-inch mesh. Two containers, each with one to two ounces of bait, were placed near the entrance to each treated colony. Fresh bait was set out from two to four times, depending upon the particular material used.

A factor possibly limiting the effectiveness of baits in the woods is the abundance of natural sources of food which may render the poisoned bait less attractive. It has been observed, however, that carpenter ants are readily attracted to certain baits in the woods. Moreover, colonies in houses normally have access to an ample supply of unpoisoned food both inside and outside of the infested houses. For this reason colonies in houses would not be forced by starvation to accept poisoned bait.

Tartar emetic and bacon rind. This bait (formula 4, USDA Leaflet 147) was prepared by sprinkling bacon rind with tartar emetic and working the poison into the bacon with a knife. The bacon rind was then cut into small pieces and warmed in a frying pan until the grease began to ooze out. Several pieces of the prepared bait were placed in each of 10 containers, two of which were placed near each supposed colony. The first treatment was made on August 19, 1938, and was followed by retreatments on August 23 and September 11, 1938.

Within a few minutes after the containers were in place on August 19, many workers entered them and apparently began to feed upon the bait. Soon afterward some of the ants were seen carrying pieces of bacon into the colonies. For about a week after the initial placement, ants were noted in the containers, but in no case were many ants thus observed after the first day. Replacement of the old bait with fresh material did not revive the interest of the ants.

On September 21, 1938, when the colonies were exposed and examined to determine mortality, six colonies instead of five were found, for one log harbored two separate colonies. Of the six colonies, five were Camponotus laevigatus and one was C. maculatus vicinus. The galleries were occupied by numerous active, apparently healthy ants. No dead ants were found either in or near the treated colonies.

This bait was ineffective in controlling the ants even though they were at first attracted to, and apparently fed upon it.

Tartar emetic and sugar syrup. Eckert and Mallis (2) reported successful control of carpenter ants in log cabins in California through the use of a bait prepared by mixing 1 part tartar emetic, 10 parts granulated sugar, and 100 parts water. This mixture was used at Pack Forest by saturating strips of blotting paper and placing them in bait containers, two of which were then placed near each treated log or stump. On August 23, August 25, and September 3, 1938, freshly prepared bait was distributed to each of the colonies that were treated in this manner.

At no time were the ants particularly attracted to this bait. A few workers entered the containers and some seemed to feed, but most paid no attention to the bait.

When the colonies were examined on September 22 and 23, 1938, it was found that one log contained two species; thus six instead of five colonies were treated in this test. Five of the colonies were Camponotus laevigatus and one was C. maculatus vicinus. No dead ants were found. Numerous living ants were present in all colonies, although in one case several galleries seemed to be abandoned.

This bait was ineffective under the conditions tested.

Paris green and hamburger. Formula 5 in USDA Leaflet 147 was followed in preparing this bait. One teaspoonful of paris green was thoroughly mixed with one half pound of fatty hamburger. The resulting mixture was warmed slightly in a frying pan and then picked apart. Approximately equal portions were placed in 10 bait containers, two of which were placed near each of five previously selected carpenter ant colonies. Fresh bait was thus prepared and applied on August 19, August 22, September 11, and September 19, 1938.

Within a few minutes after the first application many workers entered the containers and began to carry pieces of meat to the colonies. Some of the pieces were nearly as large as the ants carrying them. Although ants were observed to enter the containers for nearly a week, it was only on the first day that they seemed to be especially attracted to the bait. After the first week they avoided it completely in spite of the fact that the bait was twice renewed after that time.

When the colonies were examined on September 21, 1938, it was found that three were Camponotus laevigatus and one was C. maculatus vicinus. The fifth, which had been a small colony, was unoccupied. None of the poisoned meat nor any dead ants were found in any of the colonies.

This test is a follow-up to check results obtained in 1937 when five other colonies were treated with this bait. In the earlier test three colonies had vacated their chambers when an examination was made thirty-three days after treatment. The remaining two colonies were apparently unaffected. In no case were any dead ants found.

The results obtained to date with the paris green-hamburger bait are not encouraging. While it is definitely attractive to carpenter ants when it is first put out, it soon loses this attractiveness and does not seem to become so again, even though renewed. No ant mortality resulting from its use has been observed. There is some indication that a colony baited with this material may move to another location, possibly as a result of some of the members having eaten the poison.

Paris green and brown sugar. This bait (formula 6, USDA Leaflet 147) is recommended for controlling lawn ants, but was tested on carpenter ants when it was found that they are attracted to sweets as well as fats. The bait was prepared by mixing paris green with brown sugar in the proportion of one ounce to one pound. Two containers with this mixture were placed near each of five carpenter ant colonies on August 24, 1938. On September 4 the bait was renewed.

At no time were any carpenter ants seen feeding upon or attracted to this bait.

On October 1, 1938, these colonies were exposed and examined for mortality. No dead ants were found. Three colonies were Camponotus laevigatus, one was C. maculatus vicinus, and one was abandoned at the time of final examination. The abandoned galleries were in a very rotten, wet log which did not seem particularly suited for carpenter ants.

Judged from this test, paris green and brown sugar is unsuitable as a bait for controlling carpenter ants. Similar results were obtained in 1937 when five colonies were treated with this bait without any apparent mortality to the ants.

Fumigants and contact insecticides

In cases where carpenter ants have caused structural damage necessitating replacement of the affected wood and resulting in thorough exposure of the colony, an excellent opportunity for controlling the ants is afforded. Under these conditions the ants can be quickly killed by spraying them with a pyrethrum and oil spray, such as is commonly sold as fly spray. Suitable pyrethrum and oil spray is readily available and can be applied with the garden type of hand sprayer possessed by most home owners. Several other readily available materials, mentioned later, can also be used. No additional tests were made with this type of treatment for the earlier tests seemed conclusive that the ants can be killed if they are contacted with the spray. The principal point to stress is that the treatment be rapid and thorough so that the disturbed ants do not escape and later become reestablished.

At one time or another numerous chemicals, which act both as fumigants and contact insecticides, have been advocated for injection into carpenter ant colonies to obtain control. All of these materials, regardless of their insecticidal value, are subject to the limiting factor of accessibility of the colony. There is the further limitation arising from the necessity of confining the material, or at least the fumes, in all the inhabited galleries sufficiently long to kill the ants. Under certain conditions this type of material may be very useful, as when no critical structural damage has been done, when the colony is readily accessible, and when its limits are definitely known. Examples in point are infested telephone poles and occasionally where colonies are confined to relatively small areas in large timbers in buildings. The method is not ordinarily suitable for the common type of infestation in buildings wherein the colony is between walls, under floors, or otherwise widely distributed. Two materials, one previously tested and one new combination, were tested during 1938.

Ethylene dichloride and carbon tetrachloride (3:1). Both ethylene dichloride and carbon tetrachloride showed promising results when used individually in the tests during 1937. Since a mixture of the two has been reported as producing an efficient, non-inflammable insecticide, the combination recommended for the control of ants by Eckert and Mallis (2) was tested. The proportions used were three parts of ethylene dichloride to one part of carbon tetrachloride. From four to eight ounces of the mixture, the exact amount depending upon the extensiveness of the colony, were introduced through holes bored into the ant galleries. After treatment the holes were plugged to keep the vapor from escaping too rapidly. Five colonies were treated in this manner on September 5, 1938.

Seventeen days later, on September 27, 1938, the colonies were exposed and examined for mortality. At that time only one colony gave off any odor of the chemicals, and that one only slightly. Four of the colonies proved to be Camponotus laevigatus and one C. maculatus vicinus.

The results obtained in this test were highly variable ranging from practically no mortality to 100 percent kill. There was considerable indication that many of the galleries were abandoned, presumably subsequent to the treatment. The results of treatment with ethylene dichloride and carbon tetrachloride are in line with the variable results obtained in 1937 with all materials of this type. On the basis of tests to date, this combination of materials is not now recommended for general use for carpenter ant control.

Orthodichlorobenzene. Tests with this material in 1937 were highly variable on the three colonies that were treated. Since the original test was rather limited and because orthodichlorobenzene has been recommended by Snyder (6) for the control of carpenter ants in buildings, it was decided to run additional tests. Five colonies were selected for this purpose and treated on September 4, 1938, with 4 to 10 ounces of orthodichlorobenzene injected into the galleries through holes bored for that purpose. After treatment the injection holes were plugged with moist earth.

As determined from collections of workers taken prior to treatment, all colonies in this test contained Camponotus laevigatus. When the galleries were exposed on September 26 and 27, 1938, odor of the chemical was still quite pronounced. At that time one colony was completely abandoned; two contained a few dead ants but were mainly abandoned; one contained a few living ants but many abandoned galleries; and one medium sized colony seemed perfectly normal.

The results of this test further indicate that orthodichlorobenzene injected into a colony of carpenter ants may or may not exterminate the ants. In some cases it seems to act as a repellent causing the ants to abandon their galleries and move to other quarters. On the basis of tests to date, orthodichlorobenzene is not recommended for general use for carpenter ant control.

Dusts

The efficacy of this method of treatment depends upon the grooming habit of ants. Since they frequently clean themselves with their legs and antennae which are in turn cleaned with the mouth parts, it is presumed that a poison dust applied to any part of the body will eventually be taken internally. Therefore a stomach poison is used either directly upon the ants or indirectly by putting it in places where the ants will get the dust upon themselves by their movements through passageways or over surfaces that have been treated. If the dust is irritating to the body of the ants, so much the better, for the grooming process is thereby stimulated. Dusting is essentially an indirect method for use in places that the ants are known to frequent, but where the colony cannot be actually exposed and the ants killed with a contact insecticide.

Except in Test 5 with sodium fluoride, the method of treatment was the same in all cases. Several holes were bored with a brace and 1-inch bit in such a manner that the holes tapped some galleries of each colony. The success of this operation was usually evidenced by numerous carpenter ants emerging from the holes upon removal of the bit. Liberal quantities of dust were then dusted with a small garden-type hand duster into these holes, into any entrances that were noted, and upon any surfaces that the ants seemed likely to frequent. When the dusting was completed the bored holes were plugged.

Sodium fluoride. Gibson (4) in 1916 reported successful control of Camponotus pennsylvanicus in houses by dusting with sodium fluoride. Tests conducted in 1937 at La Grande, Washington, indicated that sodium fluoride dusted into carpenter ant galleries and runways held considerable promise as a means of eliminating colonies that could not be exposed for direct treatment. Tests with sodium fluoride were continued in 1938 and 1939 to further investigate the effectiveness of this material when applied under various conditions.

Test 1. - Five colonies of Camponotus laevigatus were treated on August 30 and again on September 12 and 13, 1938, with a total of 8 to 20 ounces of dust per colony. An external examination of the colonies seven days after initial treatment revealed from few to many dead ants on each of the refuse piles. When the galleries were exposed on September 22, 1938, two colonies contained dead ants only; two contained both living and dead ants; and one contained living ants only. In the latter case the presence of numerous dead workers on the refuse pile was the only evidence that the dust had taken any effect. There were evidences of partial abandonment in the other four colonies.

Test 2. - Five colonies of Camponotus laevigatus were treated on September 5 and 7 and again on September 17, 1938, with a total of 8 to 20 ounces of dust per colony in the combined treatments. The colonies were exposed and examined to determine mortality on September 27 and 28, 1938. In comparison with Test 1, fewer dead ants were noted on the refuse piles. When the galleries were exposed, one colony contained dead ants only; two contained both living and dead ants; and two contained living ants only. Numerous empty galleries in four of the colonies indicated that many of the ants had left, or perhaps had died outside the ant dwellings. Except for a few dead ants on the ground near one entrance, one small colony seemed to have escaped the effects of treatment.

Tests 1 and 2 were both made so late in the season that climatic conditions unfavorable to dusting were encountered. Following the second application, dew formation at night soon caused the dust to cake and become ineffective. This was also true to some extent following the first application. Conditions were progressively less favorable and this is believed to account for the difference in effectiveness between Tests 1 and 2. In order to eliminate the complicating factor of caking of the dust by dew, all tests in 1939 were made earlier in the season than those in 1938.

Test 3. - Five colonies of Camponotus laevigatus were treated on July 26 and again on July 28, 1939. In the two applications a total of 8 to 18 ounces of dust was used on each colony. One of the colonies was opened and examined on October 5 and the other four on November 2, 1939. On the day following the initial treatment from one to several dead workers were found on the refuse piles at each colony. When the final examination was made, two colonies were abandoned. All ants were dead in two large colonies. In the fifth approximately 200 living ants were still present but extensive galleries seemed to have been abandoned.

Test 4. - This treatment comprised one application of 6 to 8 ounces of dust per colony applied on July 28, 1939, to 5 Camponotus laevigatus and 1 C. maculatus vicinus colony. On October 5, 1939, one of the colonies was exposed and examined to determine mortality. The final examination of the remaining five colonies was made on November 2, 1939. No dead ants were noted on the refuse piles, but this apparent discrepancy with other tests of sodium fluoride may have resulted from the long interval between the application and the next, or final, examination. Any dead ants might have been carried or washed away during this time. When the treated colonies were exposed, only the C. maculatus vicinus colony contained any living ants; however, this colony was heavily populated. In this instance most of the galleries nearest the treatment were abandoned. The remaining colonies contained dead ants only. In all except one case some of the galleries seemed to have been abandoned.

Test 5. - This test was similar to Test 4 except that the dust was applied only to exposed surfaces about the colony and through any entrance ways that could be found. Five colonies of Camponotus laevigatus were treated in this manner on August 11, 1938. They were exposed and examined to determine mortality on October 5, 1939. Dead ants were found on the refuse pile in front of only one colony, but in this test, as in Test 4, any dead ants might have disappeared during the long interval between treatment and final examination. One large colony showed no apparent effect of treatment. Four colonies showed evidences of abandonment, one complete. Three of the partially abandoned colonies contained dead ants, but no living ones.

In summation of the results of treatment with sodium fluoride, it can be stated that under ideal conditions all ants in a colony may be killed. The degree of success ranges from this to none at all. There seems to be a definite tendency for carpenter ants to abandon colonies that have been treated with sodium fluoride. Treating under dry conditions is essential to success with this method. In the tests a single application of dust, thoroughly applied to surfaces frequented by the ants, seemed as effective as repeated applications in which some of the dust was applied through holes bored into the ant chambers. Further testing would be necessary to substantiate or disprove this point.

Sodium fluosilicate and bentonite (7:3). Light, Randall, and White (5) reported sodium fluosilicate dust as effective against Kalotermes. By inference it was reasoned that this material might also be useful for control of carpenter ants. Accordingly it was tested for that purpose. In order to reduce caking and to obtain a lighter, more readily handled dust, three parts of bentonite was mixed with seven parts of finely ground sodium fluosilicate. One test with this combination was made late in October 1937, but the five colonies that were treated showed no evidence of mortality either that fall or in June of the next year. It was thought that the unfavorable results might have resulted from caking of the dust caused by dew during the nights following treatment. Therefore, five additional colonies were treated in 1938. Two applications, the first on August 31 and September 1 and the second on September 17, were made. A total of from 12 to 22 ounces of dust was used on each colony. When the logs containing the treated colonies were cut open on September 25, 1938, it was found that one contained two species. Five of the colonies were Camponotus laevigatus and one was C. maculatus vicinus.

The results of this test were entirely negative. No dead ants were found. Furthermore, there was no evidence that any of the galleries had been abandoned.

Cube (0.9%). Cube, diluted with bentonite to a rotenone content of approximately 0.9 percent, was tested upon five colonies to determine whether a rotenone-bearing dust would kill carpenter ants. This degree of dilution was obtained by adding five parts of bentonite to one part of the cube on hand. (A sample tested in 1938 showed 4.3% rotenone and 23.4% total extractives, and a sample from the same supply tested in 1939 showed 4.8% rotenone and 22.4% total extractives.) Lack of information on the exact rotenone content of the undiluted dust made it impossible to predetermine the exact degree of dilution at the time of compounding. The aim was to obtain a dust contining between 0.5 and 1.0 percent rotenone, for the literature revealed that dusts of these concentrations were effective against a number of insect pests. No information was available as to toxicity of rotenone dust to ants. Two applications were made, one on September 1 and one on September 17, 1938. In the combined applications a total of from 12 to 20 ounces of dust was applied to each colony.

When the colonies were exposed and examined on September 25, 1938, all were found to be Camponotus laevigatus. The chambers seemed to be fully occupied with healthy ants. No dead ants were found.

Although rotenone-bearing material might have been tested more thoroughly and under conditions somewhat more favorable for dusting, the complete lack of mortality was considered as indicating this material to be ineffective for carpenter ant control. Since this limited test was made, Downes (1) has reported derris powder containing 4 percent rotenone as effective for controlling carpenter ants and wasps. In September 1940 St. George stated in correspondence that he and Baumhofer, using 4 percent rotenone, had had similar success in controlling Camponotus, Crematogaster, and wasps. St. George further stated that Mr. Neal Howard of the Bureau of Entomology and Plant Quarantine had controlled lawn ants with 0.5 percent rotenone but this concentration was slow acting.

Up to the present time, rotenone-bearing dust has not been adequately retested at the Portland laboratory. In one case during 1941 a partially exposed colony of carpenter ants was exterminated with a single application of derris purchased as containing 12 percent rotenone. In another case a colony was eliminated from a mountain cabin with dust from this same lot. Several people having carpenter ant-infested houses have been advised as to the possibility of using 4 percent rotenone, but to date none has reported back on the success or failure of such treatment. At the first opportunity field tests of rotenone in various concentrations will be made.

SECTION 2 - PRACTICAL ASPECTS OF THE CARPENTER ANT PROBLEM

Each year numerous requests concerning the control of carpenter ants are received at the Portland laboratory. Various observations that have been made in connection with 201 such requests, that have come in during the past several years, are summarized in the following discussion.

Species of carpenter ants infesting buildings

No particular effort was made to determine the species involved but in 33 cases determinations were made. Twenty of these were Camponotus herculeanus modoc: 9 were C. maculatus vicinus; and 4 were C. laevigatus. At one time or another all three of these, but principally C. laevigatus, were represented in the control experiments at La Grande, Washington. In a previous report (3) it was stated that only C. maculatus vicinus had been found in buildings in this region. Now the two other species mentioned above should also be considered as pests of dwellings.

Characteristics of carpenter ant infestations

Infestations in human dwellings are most frequently reported, but colonies in garages, other buildings, telephone poles, and ornamental trees also cause concern. In at least one instance considerable damage was done to dynamite boxes in a warehouse. There are three usual sources of complaint concerning carpenter ants in houses. First, there is the nuisance of the winged adults migrating from the colony in the spring. Often such migrations occur within houses. Second, there is the annoyance of having the workers crawling about, often getting into food. Finally, there is the actual damage caused by the ant galleries in building timbers.

Requests concerning carpenter ants have been received in every month except January, but 80 percent of them come in from April to August. Requests are particularly abundant during April and May when migration of the reproductives is at its height. In the Portland area initial flight occurs on the first warm days of spring, usually about mid-April, although winged adults leaving their colonies have been observed as early as March 20. As a rule the emergence from an individual colony occurs over a period of one to three weeks. Thousands of adults may emerge in a heavily infested house, thus causing much distress to the human occupants. Under such circumstances the method that is usually recommended to secure temporary relief is spraying the emerged ants with a pyrethrum in oil spray. For permanent relief this measure must be followed by other measures directed toward eliminating the colony.

During the remainder of the year most of the requests are motivated by activities of the workers, either in foraging for food or in boring into the wooden portions of buildings. In the case of the foraging workers, carpenter ants have been reported as getting into foodstuffs such as preserves, pastry, flour, bread, and in fact almost any food that is left exposed to them. Occasionally they are quite troublesome in this respect, but often, even in heavily infested houses, no ants are noted in food. This may be explained in part by the habit of carpenter ants to forage at night and as a result their feeding may be overlooked. In other cases the foraging seems to be largely done outside of the infested houses.

The problem of particular interest in this investigation is that of damage caused by the ants in mining wooden parts of buildings. Carpenter ant galleries have been noted in sills, stringers, rafters, window and door frames, porch pillars, flooring, and other portions of houses. Sound wood and rotten wood are both mined by carpenter ants, but the latter seems to be preferred. This may be because the ants find it easier to mine in wood that has begun to rot. Ants mine in wood to obtain shelter rather than food, and consequently their mines, even in large colonies, are relatively limited. In cases where several colonies are established in a house the damage is proportionately greater, but in no case that has come to our attention has any great structural damage been done. In fact the expense of exposing a colony to eliminate it is often greater than the cost of replacing the mined timbers.

Carpenter ant colonies in houses are not always in wood. Often, nests consisting of large accumulations of fir needles and other refuse are packed into openings in walls, under floors, and in attics. Under such circumstances the ants may be a considerable nuisance to the occupants of the house but cause very little damage to the building.

It has been stated that good structural practice will prevent infestation by carpenter ants. For example, Van Dyke (7) states, "Carpenter ants are rarely found in cities and towns... An old log house in the forest may at times be attacked, but a carefully built home even in the forest is rarely bothered." This statement has not been found to apply to conditions in the Pacific Northwest. Not only have carpenter ants been frequently found in towns and cities but also in well built houses. In one case that came to our attention an entire colony moved into a new, well-built house before the owner moved in. Another interesting point in this case was that the ants entered under the eaves. Not only was the house of exceptionally tight construction but it was built almost throughout of lumber treated with a well-known proprietary preservative. Other examples of carpenter ants entering new and well constructed houses, not to mention numerous older ones, have been noted. It is true that no particular effort had been made to make these houses ant proof, but it is doubtful whether any measure, other than making them absolutely tight, would have excluded the ants. While a house that is absolutely tight at all points is something to strive for it is a goal that can seldom, if ever, be attained in wooden construction. The resourcefulness of carpenter ants in getting into houses is illustrated by two cases in which the telephone wire was used as a means of entry.

Another statement that has been made concerning control is that when damage has occurred, future trouble can be avoided by replacing the timbers with creosoted material. This may be true of the particular timbers that are replaced. It has already been pointed out, however, that the ants may attack almost any wooden portion of a house; therefore, it would be necessary to use treated material throughout in order to avoid any possibility of trouble. Actually this is a needless precaution, when the relatively minor damage caused by carpenter ants is taken into consideration. This discussion is not to discourage the use of creosoted timbers, particularly about the foundations, but to point out that precautions that are effective in preventing damage by rot and termites should not be confused with measures directed against carpenter ants.

Sources of infestation

Several instances in which entire colonies have migrated from logs and stumps into houses have been observed. Whether colonies are established directly in buildings by a lone female has not been determined. At any rate one very desirable measure in preventing infestation is the elimination of all colonies in old logs and stumps near houses. This can be done by completely burning the infested material or by exposing the colonies and treating them with a contact insecticide. When a house is being constructed on a wooded or partially cleared lot it is particularly desirable to destroy all such colonies, for once the ants have been disturbed they are very likely to begin searching for new quarters and may move into the new house. As an added precaution it is also desirable to destroy colonies on adjoining lots.

Natural food supply

Soon after this study was initiated it was observed that carpenter ants tend aphids on Douglas-fir, often wearing well defined trails to trees near a colony. At that time it was thought that by cutting off their food supply through banding the frequented trees the ants might be forced to leave a house. Since then carpenter ants have been seen tending aphids on cedar, true fir, fruit trees, peony, and many herbaceous plants. Moreover, in watching the activity about colonies it has been observed that there is an almost constant procession of workers carrying dead insects of various kinds into the galleries. These general feeding habits make it improbable that carpenter ants could be starved out of their quarters in a house by merely banding certain frequented trees.

Control in buildings

The effectiveness of control measures in infested buildings continues to be highly variable. No thorough study has yet been made of any one method of treatment in buildings; however, several materials have been observed in use or have been reported upon by individuals who have used them. The following is a summary of the results that have been recorded to date.

Contact insecticides. Only two cases of the use of this method of carpenter ant control have been reported. In one instance a pyrethrum in oil spray was used upon the ants after they had been exposed. Treatment was thorough and complete control resulted. In the other case gasoline was used. Within two years ants again became troublesome in the house. It is not known whether these were progeny from survivors of the original colony or whether they were from some other colony.

Despite the noticeable lack of case histories to illustrate the practical use of contact insecticides, there is no doubt as to their efficacy, provided the treated colony is completely exposed and all the ants sprayed. Pyrethrum and oil fly spray, kerosene, gasoline, turpentine, and stove oil are among the readily available materials that kill ants on contact and which can be recommended wherever treatment of this type is practical. Unfortunately most infestations in houses are so situated that complete exposure of the colony is not feasible. The method is probably most useful in those cases in which the walls of a house are opened in order to replace wood that has been extensively mined.

Dusts. The use of sodium fluoride dust in ant runways has been frequently recommended and is the method upon which most information is available. Six instances are recorded in which this method proved ineffective and five in which it gave complete control. This is in line with the results obtained with the test colonies at Pack Forest and serves to emphasize the probability that variation in results is the result of differences in method of application. Even in some of the unsuccessful cases temporary relief was obtained through a reduction in the number of ants. In one case in which the dust was forced into the ant chambers the ants moved overnight to another wall of the building and became reestablished, even though many of the ants were killed.

Rotenone-bearing dust has been suggested in several cases of infestation. In the single case in which results were reported, an infestation in a mountain cabin was exterminated with 12 percent rotenone. Because of a shortage of rotenone caused by the war, it is advisable to conserve this material for agricultural pests, especially when other means are known of combating non-agricultural pests, such as carpenter ants.

Several local insect control operators have a so-called "cheap treatment" for carpenter ant control when property owners cannot afford the "first class job" which consists of cyanide fumigation. Dusting in runways and other places frequented by ants constitutes the "cheap treatment". Among the ingredients of the dusts are the following: sodium fluoride, sodium arsenate, borax, pyrethrum flowers, and rotenone. The general effectiveness of commercial treating by this method is problematical, for by the very nature of things only the unsuccessful treatments are brought to our attention.

Baits. Baiting to control ants has considerable popular appeal, for bait has the advantages of being cheap, readily obtainable, and easy to apply. In addition bait is popularly supposed to be effective for control of all kinds of ants. Often when other measures are recommended people will resort to baiting.

A number of different proprietary baits have been observed in use, but no case is known in which the ants were eliminated by this means. Several baits, especially sweetened ones with an arsenical base, are attractive to carpenter ants and kill varying numbers of them but in time the ants avoid all such baits.

Home prepared bait, consisting of hamburger and paris green and tartar emetic and lard, were noted as ineffective. In the case of tartar emetic and lard, numerous ants died after feeding upon it but soon thereafter the remaining ants avoided it. Fatty baits have the disadvantage of having to be replaced frequently in order to keep them from putrefying.

Fumigants. Information is available on the practical application of one fumigant used by injection into carpenter ant chambers. Two examples of the use of ethylene dichloride and carbon tetrachloride (3:1) have been noted. In one, control was effected and in the other the treated ant colony was reduced but not exterminated. This particular mixture, while having a number of good characteristics, is rather slow in killing carpenter ants. This is a distinct disadvantage in treating colonies so situated that there is rapid loss of the fumes from the galleries.

A common practice of commercial exterminators in this region is to use cyanide fumigation against carpenter ants. The effects of this method of treatment have been observed in five infested houses. In three cases the treatment was ineffective and in two it was apparently successful. Considerable investigation would be necessary to establish whether cyanide fumigation is suitable for general treatment of carpenter ants in houses. It does seem, however, that in the case of infested porches and similar isolated elements of buildings some supplementary measures would be necessary. There is also the question of whether the gas will penetrate to all the chambers in large timbers.

SUMMARY

Results of field tests conducted in 1937 on the effectiveness of 23 materials for carpenter ant control have been previously recorded. The present report is a summary of retests of five materials and tests of four previously untested materials. Sixty-nine colonies, treated during 1938 and 1939 at Pack Forest, La Grande, Washington, form the basis for conclusions.

Four baits were tested. All were ineffective for control, although a combination of tartar emetic and bacon rind and one of paris green and hamburger were at first quite attractive to the ants. Tartar emetic and sugar syrup attracted the ants slightly, but paris green and brown sugar was completely ignored.

Orthodichlorobenzene and a mixture of three parts ethylene dichloride and one part carbon tetrachloride were injected into colonies as further tests of materials acting as combination fumigants and contact insecticides. Results with both materials ranged from little to 100 percent ant mortality.

Three dusts: sodium fluoride; sodium fluosilicate and bentonite (7:3); and cube (0.9%), were tested. Sodium fluosilicate and cube both gave negative results. Sodium fluoride, the only material that has been tested under a wide variety of conditions, gave variable results. Under favorable conditions sodium fluoride gave satisfactory control in most cases. There was a marked tendency for carpenter ants to move following an application of this dust.

Observations made during the past several years in connection with 201 cases of carpenter ant infestation, chiefly in houses, are recorded as follows:

Camponotus herculeanus modoc was the species most frequently found in buildings. C. maculatus vicinus and C. laevigatus occurred to a lesser degree.

Carpenter ants cause concern by: (1) Crawling or swarming in living quarters, (2) getting into food, and (3) causing damage to building timbers. The latter is the problem under investigation in this study.

Infestations in houses frequently occur as a result of migrations from stumps, logs, and similar infested material. Destruction of such colonies before the ants enter houses is a sound preventive measure.

Only meager information is available concerning the practical application of control in buildings. A few known case histories are discussed. These serve to emphasize the variability in effectiveness of even the best known carpenter ant control measures.

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Table 1.—Summary of carpenter ant control tests, La Grande, Washington, 1938-39

Treatment	Colony numbers	Dates treated	Date examined	Amount of material per colony	Number of colonies treated	C. laevigatus	C. maculatus vicinus	Effectiveness	Remarks
Tartar emetic and bacon rind	141,142,144, 145,151	8/19,8/23, 9/11/38	9/21/38	4-5 oz.	6	5	1	Ineffective	Ants fed readily on bait when first applied. Later avoided it. No mortality noted.
Tartar emetic and sugar syrup	154-157, 159	8/23,8/25, 9/3/38	9/22 & 23/38	3 oz.	6	5	1	Ineffective	Ants fed but little on bait.No mortality noted.
Paris green and hamburger	147-50, 153	8/19,8/22, 9/11,9/19/38	9/21/38	6 oz.	4 or 5	3	1	Ineffective	Ants fed readily on bait when first applied. Later avoided it. No mortality noted.
Paris green and brown sugar	160-162, 167,168	8/24, 9/4/38	10/1/38	3 oz.	4 or 5	3	1	Ineffective	No feeding or mortality noted.
Ethylene dichloride and carbon tetrachloride (3:1)	169-173	9/5/38	9/27/38	4-8 oz.	5	4	1	Highly variable	Mortality varied from little to 100 percent.
Orthodichlorobenzene	178-182	9/4/38	9/26 & 27/38	4-10 oz.	5	5		Highly variable	Mortality varied from little to 100 percent.
Sodium fluoride Test 1	193-197	3[illegible]&31, 9/12&13/38	9/22/38	8-20 oz.	5	5		Highly variable	Mortality varied from little to 100 percent.
Test 2	174-177,198	9/5&7, 9/17/38	9/27 & 28/38	8-20 oz.	5	5		Highly variable	Generally less effective than test 1
Test 3	301-305	7/26, 7/28/39	10/5, 11/2/39	8-18 oz.	5	5		Variable	Not completely successful in all cases. Ants abandoned some colonies.
Test 4	306-310	7/28/39	10/5 11/2/39	6-8 oz.	6	5	1	Variable	Do.
Test 5	311-315	8/11/39	10/5/39	4-8 oz.	5	5		Variable	Do.
Sodium fluosilicate & bentonite (7:3)	188-192	8/31,9/1, 9/17/38	9/25/38	12-22 oz.	6	5	1	Ineff.	No mortality noted.
Cube (0.9%)	183-187	9/1,9/17/38	9/25/38	12-20 oz.	5	5		Ineff.	No mortality noted.